Summer 2023

How to Design and Implement a Maker Space in the K-3 Classroom

Elizabeth Nelson

HOW TO DESIGN AND IMPLEMENT A MAKER SPACE IN THE K-3 CLASSROOM

By

Elizabeth Nelson

A capstone project submitted in partial fulfillment of the requirements for the degree of

Master of Arts in Teaching

Hamline University

Saint Paul, Minnesota

May 2023

Primary Advisor: Laura Halldin
Secondary Advisor: Ryan Nelson

TABLE OF CONTENTS

CHAPTER ONE

Introduction

This paper defines the *why* of my capstone project. This work and research focuses on the process of learning through student communication, play, and creating hands-on lessons. A students day is a combination of direct instruction followed by practicing a new or learned skill. This practice often includes pencil and paper with an end product reflective of the direct instruction. These learning experiences are not bad and have proven to be effective. But it does not always foster an authentic learning experience for the student. Authentic learning engages the student in the process of learning through relevant ideas and communication. There is a need to create opportunities in the student's day with less purpose or intent, where students lead in both failures and successes. Chapter One will highlight the influences that have led me to my capstone project and research question.

My research will answer the question, *How can you design and implement a maker space in the K-3 classroom?* My project centers around creating a website that will guide and support the implementation of a maker space in the classroom. This guide will also help teachers like myself understand the versatility of a maker space in supporting students' academic needs and social and emotional well-being. Research in purposeful play supports the need for less structured experiences to help children develop executive function and self-regulation, which are predictors of academic readiness (Allee-Herndon

& Roberts, 2021). Areas such as the maker space create access to materials and ways of thinking, which have historically been available only to students of higher socioeconomic standing.

Chapter One will examine the passion behind my research question of how to design and implement a maker space in the K-3 classroom. This chapter will define the context of maker space, define what this type of space means, and shed light on my positionality and experiences with these spaces. My life's influences have led me to this specific area of research. These influences have helped me to focus my research and push me to understand the need for this work beyond my desires.

Defining Terms

"Maker space. What is that exactly?" This question is one I commonly hear. The term maker space is relatively new to education. Others may call it a 'passion place' or 'crafty corner.' I will use the term maker space for my research and this paper. The very essence of these spaces makes them hard to define. They can look and function differently in each classroom and still serve a similar purpose. Features of a maker space include an area or table with tools and materials of varying origins and mediums. Materials include found objects, cardboard, fabrics, plastic containers, and various paper products. Students use these materials with tools to create something new.

One common feature of these spaces across all variations is that the user of the space has a hands-on experience. Often these spaces are free of direction or instruction. But this, too, is not a defining feature. Students may create, be satisfied with their work, or change it, going through multiple iterations. These spaces promote communication and collaboration; however, no rules define how you work with others or what you need to

do. Halverson and Sheridan state, "Learning through making reaches across the divide between formal and informal learning, pushing us to think more expansively about where and how learning happens" (2014, p. 498). The maker space is a place that attracts students of all abilities due to the flexibility of its parameters. This flexibility is something that speaks to me on a personal level.

Personal Background

I grew up in a low-middle-class house with many siblings. We always had food on the table, but money beyond this was tight. I attended college on student loans and federal grants. I now understand this was a privilege, but I did not recognize this until I was older. I married a man who grew up in an upper-middle-upper-class household. His family has more money and stability than my own. His mother is an immigrant from a poor country with political unrest. Hearing her stories and understanding her life has helped me to see the world beyond my walls. I see my children growing up very differently from me. I work to balance this. All of this affects how I see the world and influences my work.

By nature, I am a visual, hands-on person. Growing up in a busy household of nine people, physical space and the funds needed to create freely were minimal. I remember asking for a fresh piece of paper, and my mom responded, "Just one; paper is expensive." While we likely had 'found objects' in the form of household objects or recycling, this was not something my parents would have thought about. Creating something out of a 'found object' is a relatively new concept. My parent's days were filled with just getting by with little room for free thinking. At fifteen, I could work a job and earn my own money. My naturally creative interests pushed me to explore

everything I could ‘make.’ I was lucky to be able to use the money I earned to buy the materials I wanted and needed to explore my interests. I put this money towards purchasing supplies for making lamps. These lamps were made from bottles, mirrors, found objects, and my self-taught electrical wiring skills. I began taking every building and art class my high school offered. Working with my hands and creating was, and still is, very fulfilling.

Professional Experience

These passions led me to pursue a Bachelor of Fine Arts with a concentration in Metalsmithing and Jewelry. In my professional life, I worked as a Dental Ceramist, making implants and crowns for dental offices.

An opportunity to follow another passion led me to a career change and the field of education. My first experience working in a school setting was as a ReadingCorps tutor. The focus of a ReadingCorps tutor is to improve individual students' fluency through one-on-one tutoring over the course of a school year. Students have the opportunity to exit the program by passing a fluency assessment. Many students did not meet this requirement, so they stayed with me for the entire year. One specific student was in the third grade. He had become tired of the required readings, and even though we had switched to books he liked, the fact remained that reading was hard, and he was not feeling successful. It was one tough day that his refusal to read had brought me to keep busy with another task of stapling papers together. He watched me with his head on the desk for a while, then asked, “Can you show me how to do that?” I was initially confused, wondering what he meant, but then I realized he wanted to try using the stapler. Upon recognizing this, I wondered how a third-grader could never have used a stapler.

My daughter was in third grade and well into using a glue gun. I asked, “If I give you time to staple at the end of our lesson will you read with me?” He agreed, and we created a book out of paper and staples. I then kept him engaged with reading through the end of the year by offering mini-creative outlets at the end of his tutoring sessions.

In reflecting on this experience, I can identify that this student came from a different socioeconomic and racial background from my daughter. He likely did not have a designated space filled with materials and tools starting at a young age; he may not have had the time or opportunity to explore. I do not believe this makes his situation wrong or his caregivers unfit. My capstone project is built on my belief that every student should have access to these opportunities. When we talk about equity for students and relate it to reading and math scores, we have data and numbers to guide our decisions; without data to reflect a need, do these creative opportunities become less significant?

Fast forward another year, and I am working as a Kindergarten teacher. Here again, students follow direct instructions for most of the day. This often includes step-by-step instruction with little room for free thinking. When students engage in what is deemed an art project, they are given specific instructions on what to create. These students need explicit instruction to learn what to do. After every answer they show on a worksheet, they will seek approval. We talk about being brave in writing when sounding out words and giving answers, but if students are not allowed to be leaders in their learning, how can they learn to be brave? A maker space allows students to learn how to try, then fail, or make changes to improve. This type of thinking is necessary for learning and needs to be developed. Creating something with your hands is rewarding and helps you understand how to solve problems and become an effective learner.

Positionality

Here, I will elaborate on my positionality and personal influences to better understand why this work speaks to me. I am a white woman, mother, sister, and daughter. I am a Catholic and am raising my family in this belief. I believe people should choose the religion that speaks to them. I know I am biased because I believe any religion or substantial cultural influence is positive for a child's upbringing. I know this is not necessarily true. Overall, I would choose not to be a political person and stay away from confrontation because I do not like negative energy. Because it is impossible not to be political or address social issues, I try to understand both sides of the story before taking a position. By understanding my identity better, I will be able to implement the maker space as an opportunity for students to develop their own identities.

Conclusion

We know our students are struggling, scores are dropping, and the mental health of our students is at an all-time low. Answering the question, *how can you design and implement a maker space in the K-3 classroom?* will support the teacher in reaching students. As discussed at the beginning of chapter one, by providing time for creating, communication, and hands-on work, students will experience authentic learning. This learning will, in turn, lead to emotional and academic success for both educator and student.

The research in Chapter Two dives into the maker space's history, examining what kind of learning happens in a maker space and where this learning has historically occurred. It will also look at societal and world events that influence and shift ideas surrounding 'making.' My research shows how a maker space can positively impact a

student's social and emotional learning. At a time when our students are most vulnerable following the Covid-19 pandemic, racial unrest, and political tensions, teachers and schools need to focus on the whole student if we are to expect students to meet high expectations. The research builds an understanding of the social benefits present in a maker space, showing how communication and relationships are supported. Additional questions include how the space increases motivation in academics. Plus, allowing all students to share their skills and experience success. The research explores how a maker space supports students' physical well-being and milestones, such as fine motor skills.

Chapter Two then focuses on how a maker space increases access for all students by providing access to materials and the freedom of allowing creative thinking. What mindset does this type of work support, and is it truly a mindset otherwise accessible to all students? In conjunction with this, I explore what schools offer these opportunities already. Are these schools accessible to all, or are these spaces only available to a few? Here again, I turn to societal ideas surrounding having a maker space in the general education classroom. In hopes of answering whether these spaces are welcome and beneficial to student learning. Lastly, I look at how a maker space can help to close the achievement gap in our current education system.

Last, Chapter Two develops an understanding of what these spaces look like and how they function in the classroom. Here there is an emphasis on the physical designs of these spaces, what works well in the general education classroom, and how these designs can be improved. Beyond this, the chapter examines how the maker space can support students' academic learning. Specific examples show how a maker space can support writers by making plans and labeling or readers by reading instructions. Another question

is how to include STEM applications of a maker space that will support science and math in the classroom. In conjunction with this, I explore how these spaces support the role of the teacher. Ultimately, this space becomes an opportunity for both students and teachers alike.

CHAPTER TWO

Literature Review

Introduction

A maker space is designed to be used by participants to make a product with their hands. Through making, the participant is learning through trial and error. General research surrounding maker spaces in various public settings is plentiful. The research examined below gives an in-depth review of many influences a maker space can provide. In contrast, and because of the newness of these spaces, very few formal quantitative studies exist on the effects of implementing a maker space specific to students' academic growth. There needs to be more information and research done on implementing these spaces and finding their value in the K-3 setting. Understanding these research findings found in the literature are essential to note as they relate to the research question for this project: *How can you design and implement a maker space in a K-3 general education classroom?* Below, a definition of a maker space will be provided along with two other defining terms, what it means to be a maker or to make. Following this will be an in-depth literature review describing the research.

This research examines the history of the maker space and current research trends. Next, it identifies factors that can or have affected equity and opportunity in a maker space setting, specifically, how access affects the use of these spaces and how these spaces create opportunities to promote equity. The research then discusses the social and emotional effects on learners in a maker space environment. Looking to understand better the influences on social-emotional learning connects to how we measure the use of the

maker space. Next, the research asks what effective designs and implementation strategies look like when creating a maker space for an educational setting and understanding its role inside the classroom beyond its use for play. Finally, the literature review will synthesize how these findings affect the research question, *How can you design and implement a maker space in a K-3 general education classroom?* This analysis will establish an understanding of Chapter Three.

Defining Terms

Two terms must be defined for the reader to ensure understanding as they continue through this chapter. The first is to define the term *maker space*. As it sounds, the function and use of a maker space is a space where someone, a user, makes something. Halverson and Sheridan describe the maker space as a space resembling an art studio where learners work together or independently (2014). These spaces may or may not have a prescribed task or goal. The user of a maker space participates in tinkering or freely making. Likely, the user will create a finished product by going through the design process, testing, and changing their work (Honey et al., 2013). The end product can include but is not limited to, creating a website, jewelry, abstract artwork, or a robot using found objects and other materials.

The second term that should be defined is to ‘make’ or to be a ‘maker.’ In the literature review, I will refer to a maker as a learner, ready to and in the process of creating. This learner then uses tools and materials to answer questions or build a final product. As Anne Marie Thomas writes in her book, “Simply put, makers make things” (2014, p.1). This definition is intentionally broad as the act of making is often largely a result of the learner's interests. Here too, the learner is more in charge of their outcomes

than anyone else. These terms, to make, to be a maker, and maker space, often appear in the literature review below.

History

History has a way of repeating itself. In the late 1800s, the Arts and Crafts movement emerged and gained momentum in response to over-industrialization following the Industrial Revolution (Obniski, 2008). Similarly, the birth of the maker space, as defined above, has emerged as a response to the revolution of computers and the internet, specifically their increased accessibility (Hatch, 2014). This section provides an in-depth history of the maker space in the 21st century, political influences, and its connections to constructivist learning theory. The research will then outline the trends surrounding the maker space in education.

Humans, by nature, are makers (Oniski, 2014). The natural need to ‘make’ can be traced back to our primitive history (Hatch, 2015). Humans used resources around them to make tools and wares for survival. This need then evolves; what was once critical to survival and done out of necessity becomes a choice. Humans now choose the act of making for the enjoyment of working with their hands or being the sole creator. Often this choice is only available to those whose survival depends on making. Historically, this has divided people into groups—those who ‘make’ for survival and those who ‘make’ for enjoyment. The latter often becomes accessible only to those who pass through elite social circles (Obliniski, 2014). The above-mentioned Arts and Crafts movement exemplifies this shift. These societal shifts result from a response to significant cultural changes (Hatch, 2015; Olinski, 2014). By understanding history and how humans have

evolved as makers, we can better look to our present to examine the 21st-century maker and learner.

Most researchers point to the launch of the magazine “Make” by O’Reilly Media in 2005 as the start of the 21st-century maker movement (Thomas, 2014). Considering this and then reflecting on history as mentioned above, we can see that the technological revolution of computers and the internet directly influenced the maker movement of today (Hatch, 2014). It is clear that in the early 2000s, a shift began to happen that set into motion the idea of a maker as no longer limited to the elite or businesses. Producing a product becomes something accessible to everyone.

Political figures began to embrace this shift by showing support for the maker movement; in 2009, President Obama endorsed the maker experience through the Educate to Innovate Campaign, stating:

> I want us all to think about new and creative ways to engage young people in science and engineering, whether it’s science festivals, robotics competitions, fairs that encourage young people to create and build and invent—to be makers of things, not just consumers of things. (Obama, 2009)

The support of President Obama and his campaign garnered significant political and social momentum for innovation and the maker movement (Halverson, 2014; Mann, 2019). The first public maker spaces began in museums and libraries in the early 2000s (Halverson et al., 2014). Following this, community maker spaces began to pop up and serve specific populations (Tomko, 2021). People could now have step-by-step plans to create ideas through sources such as Make Magazine, increased access to computers and

technology, and the internet (Hatch, 2014; Halverson et al., 2014). A perfect example is the explosion of do-it-yourself and how-to videos on various social media platforms.

In academia, newly implemented Next Generation Science Standards focus on "design and implementation" (Halverson et al., 2014, p. 506). The science standards draw on the engineering design process. The engineering design process steps are: ask, imagine, plan, create, experiment, and improve (NASA, 2018). These steps are done in no particular order allowing for free exploration, which puts the student in charge of their learning; this is an important feature of the engineering design process. In this free exploration, connections can draw from the new science standards to the maker mindset. These shifts in education are a substantial shift in mindset for most educators. They share common ideas with the maker movement in how participants go through the learning process. This process has significant ties to constructivism, as described below.

Constructivism

The design process above and the work done by a learner in a maker space employ aspects of constructivist learning theory. In constructivist learning theory, the learner asks the questions and then tests their theory through trial and error. Learners can then discuss, modify, and defend their ideas with other learners (Fosnot, 2005). In constructivist learning, the students are in charge of their learning as much as the teacher. People often think of constructivist learning theory and think of only hands-on learning. While a maker space does employ the learner to create using their hands, it is the process of learning, in which the student freely plans, creates, and modifies, that leans on constructivist theories (Fosnot, 2005). Konstantinou describes best what it means to participate in a maker space as a learner:

> Learning by making is a contemporary interpretation of the pre-existent constructivism and constructionism learning theories in accordance with the use of technology, handling special equipment such as 3D Printers, Robots, Circuits, Sensors and Laser Cutters. Piaget & Cook (1957) defined the "constructivist" learning theory as the "embodied" learning theory of nowadays. (2021, p. 224)

While the modern-day maker space can employ special equipment and technologies, as mentioned above, this is only sometimes the case, and a maker space can often be home to simple items and tools often directly reflecting the students' interests.

Research Trends

While researching the history of a maker space, it became evident that there are significant trends in research. Before 2000, very little information is available specific to the term maker space. The term maker space started appearing in search results in 2000 and later. Most articles and studies cited in the literature review were published in the early 2000s or later. The information found in the research from 2000 through 2015 discusses what a maker space is, how these spaces function, and how these spaces impact the general public. In the years beyond 2015, research and information published started to analyze how maker spaces function and discuss how the maker space concept is applicable in the educational setting. As the research moves into more recent years of 2018 and beyond, studies begin to ask and answer if the maker space is effective at improving academic outcomes for learners or if these spaces are just another fad in education (Konstantinou et al., 2021). Providing measurable studies has proven difficult as the data needed would measure social-emotional behavior which is a subjective measure.

Equity and Opportunity

The research discussed in this section explores equity and opportunity within the maker space; specifically looking at access to these spaces in education. It identifies equitable considerations and looks at what opportunities are most significant. Questions answered include what social and political influences, such as funding, affect these opportunities. Next, this section discusses how vital the maker space experience is for learning, specifically for those considered low- to the middle-class. Research in this section then discusses the importance of opportunities like the maker space to develop the skills needed for success later in life. Finally, the research examines how accessible materials and ideas are to women learners.

In the education world, the word funding is present in every decision. Institutions, districts, and schools want to see where money is going. They also want to see measurable results from these investments. Funding is one of the most significant barriers to implementing a maker space learning experience. Because funding is not readily available, these spaces look to outside sources such as fundraisers or community organizations. Families in low-income and middle-class communities can find these funds challenging to attain and maintain (Hwang, 2018). This lack of funding decreases access to maker space learning for large portions of the population.

On the contrary, others like Gerstein argue that to increase accessibility, we must "understand that entry into maker education experiences does not need to come exclusively from high-tech devices" (2019, p. 41). Dougherty points out that through the internet and technology today, making is no longer only for those in the upper middle class. With increased access, we see making happening in all areas of society (Honey &

Dougherty, 2013, p. 8). Jackie Gerstein highlights the importance of local non-profits such as RAFT in Los Angeles and its influences on supporting the maker space in the classroom (2019).

Studies have shown that the students who benefit most from creative opportunities such as making and free play are the low and middle-class populations (Alle-Herndon & Roberts, 2021). The brain of a child who grows up under the stress of poverty lacks the foundational skills necessary to progress in learning academic readiness skills (Allee-Herndon & Roberts, 2021). These foundational skills are specific to a child's executive function, such as their ability to build cognitive and social competencies and self-regulate their bodies and minds (Blair, 2016). All of these skills are necessary to find success in the classroom.

One way to develop these foundational skills is through play-based learning or purposeful play (Allee-Herndon & Roberts, 2021). Vital elements of purposeful play include arts-based play, visual and performing arts, and artwork promoting fine motor skills (Allee-Herndon & Roberts, 2021). These elements are the essential foundations of working in a maker space. These critical components of the maker space experience are essential to developing skills through the opportunity to create freely and work collaboratively with others (Sheridan et al., 2014). In turn, the maker space and play-based learning create opportunities for the students to develop the foundational skills needed for academic growth. Considering this, educators can increase inclusivity by being more open to what a learning experience might look like for a student (Gerstein, 2019). Scholars such as Deb Curtis and Margie Carter have written similar ideas, seeing

the child as valued, specifically, “valuing different cultural funds of knowledge as equally worthy” (Curtis & Carter, 2013, p. 9).

Other ways of increasing inclusivity are found in studying the maker space setting. This is seen in Reggio Emilia's philosophy of maker space and its setting. The Italian philosophy “addresses the whole child by addressing socio-emotional learning and expression of identity through material use”(Gurjar, 2021, p. 50). When developed early, these skills can support the child's socio-emotional and identity development by making. This philosophy emphasizes the teacher being an active listener alongside the student who becomes an active, competent contributor to their learning (Gurjar, 2021, p. 50).

To increase active engagement and authentic experience, teachers must ensure that learning is inclusive and that opportunities for materials and lessons are culturally relevant to the user (Hwang, 2018). Providing inclusive opportunities to a maker space early on has been shown to increase student engagement (Halverson & Sheridan, 2014).

On the contrary, other studies suggest that not all students sustain motivation in the maker space environment over time (Vongkulluksn et al., 2018). The study concludes that students who lack basic science, technology, engineering, and mathematics (STEM) concepts or knowledge of tools and materials, lose interest in their work because a maker space relies heavily on the student's knowledge as a guide (Vongkulluksn et al., 2018). Students that lack this knowledge will need careful scaffolds to self-initiate and stay motivated in the maker space environment (Vongkulluksn et al., 2018).

Similarly, other studies note the gender disparities in science and maker space communities; women are often underrepresented in these groups, making it harder for them to feel motivated to participate (Tomko et al., 2021). Similarly related research

showed that having quality access to a maker space from a young age helps to change the narrative on gender expectations for women in science (Tomko et al., 2021). The article discussed above from Academic Pediatrics supports early classroom interventions in play-based learning. These interventions will help students to learn how to self-regulate and improve executive function skills throughout a child's life (Blair & Raver, 2016).

In the past, learning through making might have occurred in the home. Looking at the 21st-century lifestyle today and then coupling it with the COVID-19 pandemic, we see a significant increase in learners' screen time exposure at home and school (Li et al., 2021). A recent Canadian study looked at the amount of screen time a child consumes, then the child's overall mental health. Results of the study showed that children's mental health is suffering, which directly correlates to the amount of time spent on an electronic device. This study occurred at the height of the COVID-19 pandemic and included time spent on the screen for at-home learning. The study found specific side effects of screen time on mental health; these included inattention, hyperactivity, conduct problems, depression, and anxiety (Li, X. et al., 2021).

In 2016, the World Economic Forum published an article that highlighted the top skills needed for survival, these were solving complex problems and critical thinking. Following these skills was the need for creative thinking. When attempting to provide equity for our students, what better way to prepare them to be successful and feel valued as a member of society than by offering them access to problem-solving, critical thinking, and creativity in a maker space at a very young age?

As Allee-Hernadon and Killingsworth Roberts stated, “purposeful play may be the best solution to help ensure an equal and equitable educational playing field” (2021, p. 54).

Social-Emotional Impact

As noted above in the research trends section, it is hard to measure the impacts of a maker space on groups of students. There is no standardized assessment for this (Hwang, 2018). Without this data, education can look to other impacts. Within this next section, the research will examine how the maker space can affect the social and emotional well-being of the student as well as address impacts on behavior. These include how a maker space promotes a growth mindset, how play plays a role, and communication. The research will seek to understand the maker space's effects on emotions, motivation, and self-efficacy. The research will analyze the impacts a maker space can have on developing a student's creativity, problem-solving, and critical thinking. All three of these skills have been deemed necessary 21st-century skills by the World Economic Forum (Gary, 2016).

Dale Dougherty writes about the magic and power of bringing the maker space to education. He writes that we will be able to “create a context that develops the maker mindset, a growth mindset that encourages students to believe they can learn to do anything” (Honey et al., 2013, p. 10). Carol Dweck echoes this in her work on motivation and the power of mindset. People with a fixed mindset believe their intelligence is fixed as well. They believe they will continue to learn, but that one is either born with a certain amount of pre-decided talent. People with a growth mindset believe they can learn and change. One is not born with talent but acquired through hard work (Dweck, 2016). So much of working in a maker space is devoted to problem-solving and critical thinking. An integral part of problem-solving and critical thinking is that the learner does not

experience success immediately. Failure to succeed instills values about the importance of the process and then the growth found in the learning (Dweck, 2016).

The research analyzed play-based learning or purposeful play as an equalizer necessary for equity in the classroom. Here, the research discusses the benefits of play-based learning thoroughly. Zosh explains what has happened to opportunities for play in school. Play has significantly diminished over the last decade due to standardized testing. Teachers feel the pressure for students to perform well on a standardized test, then increase their academic time. This focus has shown declining test scores (Honey & Zosh et al., 2016, Ch. 7).

Research shows that unstructured play is just as crucial for mental health as physical health. Unstructured or purposeful play supports children in reaching cognitive, social, and physical milestones essential for building knowledge and success (Honey & Zosh et al., 2016, Ch. 7). The Next Generation Science Standards show an educational shift to the design-make-play model (Honey et al., 2013, p. 26). Experimental play is a core concept of maker space learning and supports learning (Honey et al., 2013).

Changes in the classroom culture can have a positive impact on students' behavior. In a study by Alvaro Gomez, the maker space was observed to see how it can affect the learning of students with emotional or behavioral disorders. His findings show positive results for students with emotional behavior disorders in the maker space environment, specifically in increased social opportunities and engagement (Gomez, 2019). His study shows that a shift in the classroom ecology provides safer opportunities for students to express themselves, noting that students' moods and enjoyment improved (Gomez, 2019).

Similarly, other researchers have found strong relationships between positive emotions and personal interests (Vongkulluksn et al., 2018). The study shows that students had high positive emotional reactions to the maker space instead of negative emotions (Vongkulluksn et al., 2018, para. Discussion). The study suggests this positive reaction to the maker space was due to increased ownership and high self-efficacy.

In contrast, the study found that decreased self-efficacy in the maker space created negative emotions. Researchers believe this is due to overambitious goals and a need for more scaffolding on the teacher's behalf (Vongkulluksn et al., 2018). This study also found that these negative emotions were more significant in students of higher-level classes. Similarly, Alvaro Gomez noted frustration and strong emotions in participants when things did not go as planned. In this situation, the teacher's calm guidance helped direct students with Emotional Behavior Disorders (Gomez, 2019).

Communication is crucial to the maker space environment. In these spaces, students can lead, teach others new skills, or share ideas. Alternatively, students may not choose the leadership role but still provide valuable knowledge and expertise to the space. Both roles are suited to the student's learning preference. Peer interaction benefits students learning by increasing shared knowledge, involvement, and motivation (Almulla, 2023).

In the Reggio Emilia philosophy, communication with the teacher changes from direct instructor to a co-enquirer, shifting the balance of power in learning and increasing motivation. Teachers then scaffold the students' thinking by asking questions and encouraging the making process (Gurjar, 2021). Similarly, the Next Generation Science Standards are changing the classroom culture by promoting group-based learning

environments that encourage discourse among students (Honey et al., 2013). In a comparative study of three maker spaces, researchers found that:

> While it may be easier to design, teach, and study more constrained "making activities," the learning in the making we observed in our studied maker spaces extends beyond this. Being a maker in these spaces involves participating in a space with diverse tools, materials, and processes; finding problems and projects to work on; iterating through designs; becoming a member of a community; taking on leadership and teaching roles as needed; and sharing creations and skills with a wider world. (Sheridan et al., 2014, p. 529)

Becoming community members, whether in a classroom or other space, builds our social and emotional being.

Within a maker space, a certain amount of learning occurs as free exploration or innovation; this may be in response to learning about a new program or tool (Honey et al., 2013). Other researchers refer to this as 'tinkering' (Gerstein, 2019). Students' interests drive this tinkering and free exploration, which creates motivation, authentic learning, and creative thinking. From here, students often pursue making as producing an end product. This intentional pursuit will likely follow some aspects of the design process, reinforcing students' critical thinking (Tomko, 2021). Honey writes, "at the heart of 'tinkering' is becoming stuck and finding a way to become unstuck' (Honey et al., 2013, p. 13). When this happens, our students find satisfaction in learning by developing their problem-solving skills.

A standardized test can not measure our students' social and emotional well-being. However, does this mean students' social-emotional well-being is

insignificant in our student's ability to learn or be community members and learn in our schools? Hwang (2018) suggests that education has shown they can measure academic growth with standardized tests. Comparing a classroom with a maker space and one that does not may show it does not hinder academic achievement. The social-emotional learning skills of the student will remain unmeasurable by leaders' standards, but the teacher will be able to assess this on a personal level (Hwang, 2018).

Design and Implementation

Research has shown that implementing a maker space takes many different forms, making the design of these spaces endless in possibility. Below, the research examines effective processes in designing a maker space. Next, the research will discuss and seek to understand the best practices for learning, explicitly incorporating making into the curriculum. The research then helps to define these spaces in relationship to the teacher's role. Lastly, the research looks at criticisms of these spaces. Are they just a trend? Do they stand a chance against the institutionalization of education in the 21st century? (Halverson et al., 2014)

Many successful maker spaces are member driven within a specific community. There is typically a fee attached to becoming a member. These spaces function well because this fee is used to acquire many tools and materials. The types of tools and materials purchased for a maker space are most often specific to the interests of its community members (Baniskis, 2014). In education, expensive tools and materials are not necessary. Here, the emphasis is placed on the process of working in a maker space and the goal of the product (Halverson et al., 2014).

Sheridan found a common thread in a comparative study of three maker spaces. With that, learning in a maker space is “deeply embedded in the experience of making " (Sheridan et al., 2018, p. 528). This study also showed that for learners to participate and feel successful in a maker space, there must be choices in what they work on and how they work. This choice provides an authentic experience, increasing student motivation (Sheridan et al., 2018). A challenge is that education leaders want to hold this environment accountable for measurable learning (Halverson et al., 2014).

One answer to staying accountable is incorporating the maker space into the curriculum. In order to keep this, “educators need to approach their curriculum and lessons with a maker mindset” (Gerstein, 2019, p. 81). Figure 8.1, titled “Maker Education Lesson Plan,” we see a lesson plan focusing on using the maker space to teach a lesson (Gerstein, 2019, p.83)(see Appendix). The lesson's challenge statement guides the student and creates the lesson's focus. This focus benefits both students and teachers by still offering free choice in learning but maintaining some cohesiveness among students in working together (Gerstein, 2019). Other benefits of having a specific focus for participants in these spaces will be explored later in this section. To maintain accountability within a maker space, teachers should expect and require student-driven assessment of their process and finished product in the maker space (Gerstein, 2019). Without this assessment, students may miss the opportunity to reflect and learn from their failures.

As mentioned in the literature review above on social-emotional impacts, measuring SEL skills is often subjective (Hwang, 2018). To create these authentic experiences, students must sense the freedom to create within the classroom's physical

space. The educator must intentionally set the physical space of a maker space. In the Reggio Emilia Italian maker space, educators are to be intentional in material selection as well as the arrangements of the room (Gurjar, 2021). Gerstein writes about the specifics of creating a maker space. This includes creating an agile and flexible learning environment. In these environments, furniture is not to control the student but to provide flexibility for student work. This furniture should include flexible seating, movable tables, accessible whiteboards, and shelving for students' use (Gerstein, 2019, p. 56). Furniture used for the maker space, such as tables and the surrounding floor area, should allow for messiness and allow the user to rearrange as needed (Gerstein, 2021).

The different materials in a maker space should present as many loose parts that learners can use to tinker (Gerstein, 2021). Basic materials should include paper products, writing and coloring utensils, paper clips, rubberbands, scissors, and tape (Gerstein, 2021). Found objects can be as simple as paper towel tubes, clean bottles, or cardboard (Hatch, 2014). More advanced materials can include robots, sewing machines, circuit boards, and computers (Sierra, 2017). Some communities may support teachers in their quest for maker materials. In Los Angeles, a non-profit called RAFT, Resource Area For Teachers, acquires found objects and donations from companies. They then examine and group these materials for specific lessons or use. These resources are then available to teachers to use in their classrooms at a nominal rate. Mary Simon's goal in creating this space was to give teachers access to materials while saving them time and money and to specifically promote hands-on learning (Honey et al., 2014).

The research points to the maker space as supportive of the teacher's role in helping students learn. However, many teachers need a background or formal education

in developing maker spaces or making (Tomko, 2021). If educators have experience, it is likely to be in a specific skill and knowledge of tools. Kristin Sierra started a library maker space in Tacoma public schools. She relied on donations and skills from other educators and community members in starting the library maker space (Sierra, 2018).

In the literature examined, there are many cases where educators were fearful of the unknown involved in creating a maker space. These educators needed to gain the skills and education surrounding this work. When these educators pursued the maker space and grew in their learning, they were surprised by what they accomplished. These educators saw growth in their ability to understand the new tools, programs, and concepts beyond what they initially thought (Gerstein, 2019; Sierra, 2014). Similarly, Shannon Crawford speaks to the strength of partnering with others of varying interests and expertise to create a more diverse maker space (Barniskis, 2014).

Crawford also notes that these spaces come with a fair amount of chaos and responsibility for the teacher. A large portion of these responsibilities is facilitating planning and documenting the process. Another important role of the teacher is to provide students with feedback. This feedback is mandatory in a successful maker space (Gerstein, 2019). The teacher is also responsible for facilitating and teaching learners how to give feedback because it builds the community that is critical to the function of a maker space (Gerstein, 2019). Educators and professionals who create these spaces have noted that the maker space can be manageable with a focus. This focus can look like a "Challenge Statement," as suggested by Gerstein (2019). This focus should not impede or stifle creativity, as we know the motivation and interest of working in a maker space

lessen with more constrained activities (Sheridan et al., 2014). This focus is to aid the facilitator in attending to each learner in the space (Sierra, 2017).

When looking to start a maker space in an educational setting, it can be essential and helpful to examine why, as the teacher, you want a maker space and your ultimate goal in implementing this hands-on work (Hwang, 2019). Secondly, the teacher should examine who their students are, what influences affect this community of learners in their lives outside the classroom, and whether these maker space opportunities are relevant (Hwang, 2019). We must be careful not to provide materials and ideas for one part of our population but to be proactive in thinking outside the box to create more equitable opportunities (Gerstein, 2019). Addressing these questions will guide the formation of new maker spaces.

So is the maker space just a trend? Do they stand a chance against the institutionalization of education in the 21st century? Barniskis (2014) argues that many critics will say that the items created in maker spaces are trivial. Many educators see this opinion as uninformed speculation. Professionals, educators, and community members working in these spaces have seen students create art, make tools, and fix equipment (Baniskis, 2014). Others, like Honey, argue that learning is present and can be seen in increased engagement, purposeful planning, new strategies that emerge due to tinkering, and support found in a learning community (Honey et al., 2013). She also points to “the process of becoming stuck and unstuck is the heart of tinkering. It is in this process that authorship, purpose, and deep understanding of materials and phenomena are developed” (Honey et al., 2013, p. 55).

Conclusion

This literature review has provided an in-depth understanding of the history of the maker space. Here, research trends are highlighted; these trends in research help the reader to understand the newness of the maker space in education. Because of this newness, few qualitative studies provide specific evidence of the maker spaces' effectiveness in promoting academic learning. The review describes the maker space and its relationship to social-emotional learning. The research on equity and opportunity in a maker space environment moves alongside and in conjunction with social-emotional understanding. They understand how equity and opportunity impact the users of these spaces in creating barriers and bringing opportunity. Lastly, the research helped define what these spaces look like, what questions teachers need to answer when designing and developing these spaces, and how to build the maker space into a classroom schedule to use daily. This literature review will guide the work in Chapter Three as I define my Capstone Project. This project will be a resource available to all teachers as a published website. This website will answer the question, *How can you design and implement a maker space for the K-3 classroom?*

CHAPTER THREE

Project Overview

Introduction

The maker space has gained popularity in public spaces since the early 2000s. In education, it has picked up momentum as a tool to offer authentic learning with a focus on the process and result (Hatch, 2014). A maker space is, as it sounds, a space where learners make things.

The research surrounding the use of the maker space is new to the world of education. Most studies look to prove or disprove the effectiveness of a maker space on academic learning. The conclusion of these studies shows that these spaces are not measurable through standardized assessment. However, educators' accounts of working with and in these spaces note the positive effects seen in students, both in their social-emotional learning and how the maker space promotes academic learning.

Most importantly, all studies point to the maker space as beneficial when the educator is well-versed in creating a functional space supported by the teacher and implemented into the daily learning routine. For these reasons, a website as a resource is most appropriate and supportive to answer the question: *How can you design and implement a maker space in the K-3 classroom*?

Chapter Three provides a project overview. The project overview includes a description of my capstone project as a website and the rationale supporting my decisions within the website specific to content and usability. Chapter Three also addresses who the target audience is for the website as well as understands how I will use assessments and

reflection within the website. Last, the chapter provides a summary and sets an understanding of the information coming in Chapter Four.

Project Description and Rationale

My capstone project is a website at the web address www.MNMakerEducation.com. The goal of this site is to support teachers in setting up and implementing a maker space in the K-3 classroom. A maker space is most successful when teachers adopt the 'maker mindset' (Gerstein, 2019). Because of this, a website is the most beneficial resource to someone or a group who is already interested in developing a maker space in their classroom. Users will be able to use and interact with the website as needed. An important feature of this website is the opportunity for uploading and sharing maker space lessons. One of the most significant variables to a successful maker space in education is the need to combine the ideas, skills, and talents of other educators (Barniskis, S.; Gerstein, J., 2019; Sheridan et al., 2014). Providing opportunities for sharing ideas between teachers will support this work.

A website is most accessible when the intent of the site is clearly stated, and the content is organized and free of unnecessary distractions (U.S. Department of Health and Human Resources, 2006). The ultimate goal of this website is to support the teacher in the implementation and use of the maker space throughout the school year. This website is supported and designed using the resource "Research-Based Web Design and Usability Guidelines" from the U.S. Department of Health and Human Services. This document helped me to focus on proper page layout, accessibility, links, and navigation. The website was built using the online web builder Squarespace. Using a template provided by Squarespace ensures I have built a highly intuitive site which is a benefit to the user

experience (HHS, 2006). Staying within the template for color, text, and font ensures that each page is consistent with the next in both design and function. Another added feature and benefit of using Squarespace is the ability to design my website for both desktop and mobile views.

Website Specifics

The website itself has seven main pages, these pages include Home, Mission, The Space, Setting Up, Mini-Lessons, Feedback and Sharing, and Donate. I will provide a brief description of these pages here. The Home clearly states the website's goal, introduces myself as the author, and provides the user with instructions on how to use the Feedback and Sharing tab. Next, the Mission page discusses why you should implement a maker space in the K-3 classroom, from setting up to lesson plans. An important aspect of the website is to have teachers submit their own ideas and lessons to the website. Under Mission, I talk about this work and provide access to the Feedback and Sharing tab. The third page is The Space; here, the user will learn more about the specifics of a maker space. This page provides a brief description of what a maker space is and what the user can expect to find under the Setting Up tab. This webpage directs the user to the Setting up Tab next.

Setting Up has three categories. These are Table, Materials and Tools, and Mindset. Each has a description with a button for more information on each topic. Under the Table button, the user will find considerations in selecting a maker space table, as well as plans and pictures of a completed Do-It-Yourself table. Here the user will find a materials list, measurements, and a step-by-step guide for making the table will be provided. The intent of the table design is for it to be flexible enough in its function that it

can easily be used in any classroom. Pictures will also be provided to help support the learner in what the final product will look like. The materials and tools button gives the user information on setting up their maker space with specifics on what tools and materials will work best. Users can access PDF printouts introducing the maker spaces to families including items to be donated.Within the Mindset button, users have access to a selection of resources that I have found helpful in developing a maker mindset.

The next page is Lessons. On this page, the user sees a brief description of how to use these lessons. The lessons featured are from kindergarten through third grade. Each grade has its own page. Right now, each grade has two lessons, one to support math and one to support literacy. From here, the goal is to build more lessons and gather ideas from other educators through the Feedback and Sharing pages of the website. The Feedback and Sharing page contains a form with text boxes for the user to fill out. From this initial contact, I will share a fillable Google Doc to the user. This document will be a replica of the Lesson Plan Template.PDF, also found on this page. On this page, I have also included a site survey. This survey will provide me with critical feedback. Donate is the last page featured on the website. The Donate tab contains another fillable form. Individuals or local businesses are encouraged to contact me with material donations. As this community grows, it will be the goal to redistribute these materials to teachers. From the Donate page, users can also make general inquiries.

The header and footer of the website all contain the same information on each page to help facilitate navigation, whether you are at the top or bottom of a webpage. The footer contains a link to Instagram. I created a social media account on Instagram for MNMakerEducation to increase exposure to the site. As lessons are created, I will use

photos to capture the idea and link this back to the website to increase traffic and information sharing between multiple platforms.

Using these ideas and resources has helped to guide this website to be sure teachers have the best chance for success in using the content effectively in this virtual space.

Target Audience

This website's target audience is any school in an urban or suburban location. The users will be teachers and educators in grades K-3. It is specific to these grades because it provides lesson plans and guides for a K-3 daily schedule. However, any person with access to the internet will be able to interact with the space.

Another factor influencing the audience of this website is the inclusion of specific plans to build a maker space table. The measurements in the table plans are specific to the ages 5-9. Example lesson plans are suggested for grades K-3 and include hands-on experiences. A maker space in grades 4-6 would likely incorporate more technology and different tools and materials.

This information on the website can be used individually or by a team of teachers and applied to the PLC. The power of making choices is at the heart of learning in a maker space environment. Similarly, the teacher's use of a maker space is shown to be most effective when they adopt the maker mindset (Gerstrein, 2016). For these reasons, this website is most effective when the teachers or teams participate by choice.

The information on this website is intended for schools whose students need support with hands-on learning and constructive play. Historically, this would be a low-income or Title One school; our students are considered middle-class. The research

and personal experiences support the use of hands-on work to impact these settings significantly. Because learning is a community endeavor, this space can also be as supportive for the teacher as it is for the students.

Timeline

A website is always growing and changing. Before starting any work, I read through and familiarized myself with the resource “Research-Based Web Design and Usability Guidelines” by the U.S. Department of Health and Human Services. I used the website guide provided by Hamline to evaluate my decisions. These resources helped guide all future decisions.

The initial implementation of this website started with selecting a web address and purchasing the domain name. From here, I could select the interface to build the site. After defining the goal and introducing myself as the author and administrator of the site, the next steps included adding the most important content to the site for the user's understanding. This was followed by designing lessons and creating examples, then uploading these materials to the site. Next, I spent two weeks designing, building, and documenting a Do-It-Yourself maker table, then uploading these materials to the website and providing content on space and table considerations if users want to repurpose a table they can access. Last, I worked to incorporate usable assessments within the website; these include the Feedback and Sharing, Site Survey, and the Donate feature. All of this has taken place within an eight-week period. This work was followed by another two weeks of editing and formatting the website and its content to be sure the user has the best experience possible. To help facilitate this editing, I have selected a sample group of users ranging from novice to experienced. They utilized the site to provide me with

specific feedback on what works well and what needs to be changed. The site has been published after a ten-week period. After this launch, the website will need time to gather users and more content through the Feedback and Sharing pages. I anticipate a full year to establish the site.

Reflection and Assessment

A key piece to the website's success is the opportunity for users to share lesson ideas by submitting a new idea or lesson. After the initial submission, I will provide access to a fillable template. I will then be able to review the lesson, making changes as needed before publishing it to MNMakerEducation. There are two other opportunities for me to gather data and assess the usability of the website and the quality of the information provided. Within the website, there is a site survey asking questions that help the user reflect on their experience and allow me to make changes to enhance the user experience. Users can use the donate tab for general inquiries or to start the donation process. With this feedback, I can gauge the website's success while reflecting on feedback and making changes as necessary.

Conclusion

Chapter Three defines the question of my project; *How can you design and implement a maker space in the K-3 classroom?* This includes why I chose to present this information as a website. Next, Chapter Three outlined the project description and rationale. Website specifics include what content is represented and how the user is intended to use this space. From here, the chapter defines the intended audience. An overview of the assessment and assessments attends to the user experience and success of the website.

In Chapter Four, I will reflect on the learning from my literature review and how this has affected the development of my capstone project. It will highlight the most influential research. This chapter will examine the implications of my project, including the limitations of this project and what these limitations mean for future work and research. I will also discuss how these limitations could be potential areas for growth in the maker space for education. Chapter four will conclude by sharing how this project has enriched the education profession for both teachers and students.

CHAPTER FOUR

Conclusion

Introduction

The maker space in the classroom can have many different looks; at its core, it is an area where students create a product using their hands. The parameters of lessons vary from free creation to structured lessons.

This capstone project answers the question; *how can you design and implement a maker space in the K-3 classroom?* By asking this question, I imply a need for this work or that implementation will lead to positive outcomes and success for students. Through my research, I have found this may not always be the case. What lies beneath this question is my desire to reach all my students on some level. Implementing a maker space may be the answer for some teachers and students.

In Chapter Four, I will reflect on major learnings that took place during this entire process. I will revisit the literature review, highlighting the most impactful resources to help me understand and answer my research question. Next, I will review the implications of this work and how these implications lead to certain limitations. Then I discuss the future plans of this project, specifically the website. Lastly, I share how this capstone project has enriched the education profession.

Reflection

Transformative. When I reflect on the work I have done for this capstone project, transformative truly is the adjective I would use to describe how much I have grown in knowledge and skill as an educator and learner. I can say I did not know exactly where

this work would take me as I began this process. I wanted to create something that would grow with me over the years.

In focusing on building a website, I can access, refine, and change this content as long as I see an opportunity for the maker space in education. At the heart of the maker experience is the focus on the learning process as much as the end result. For myself, the inquiry, research, and creation of a website as a capstone project has proven to be a process of learning. I have never created a website, thought about an audience, created content, and planned the logistics. Pushing myself to do so has been a making experience for me. I feel stronger about this and more likely to explore these tools when working with students and other educators in the future.

In my research, I learned that a maker space is mostly a positive experience for the student, but sometimes this is not the case. This is often the result of a student's personal preference or the need for more experience developing maker skills. This can result in a negative experience for students and teachers. Learning in a maker space or hands-on comes naturally to me and is something I focused on in getting a Bachelor of Fine Arts as an undergrad. Understanding this as part of my identity and reflecting on the research helped me understand people's varying abilities and interests in learning and using a maker space. This new learning gave me a valuable perspective as I worked to create my capstone project. It also influenced the website's purpose as a place where educators can share maker space ideas and lessons.

Literature Review Highlights

In conducting my research for the literature review, I noticed trends in the periods of the research or articles being published. Most research and articles are published after

the year 2000. Within this time period, one can see how the maker space has developed in conjunction with societal and political acceptance. The research shows that articles from 2000-2015 focus on what a maker space is and its positive impact on the general public. Beyond 2015 researchers started to analyze how these spaces function and whether these spaces could have an impact in the education setting. From 2018 to now, researchers and articles have focused on studies or the lack of studies to show the impacts of the maker space on academic outcomes (Hwang, 2018).

History

With this understanding of the newness of a maker space, it is important to note that many experts agree that 'making' or creating with your hands is a natural human experience. Something we credit our survival to (Hatch, 2014; Obniski, 2008). Other scholars link the maker space to constructivist learning theory. In constructivist learning theory, the learner asks the questions and then tests their theory through trial and error. Learners can then discuss, modify, and defend their ideas with other learners (Fosnot, 2005). Both are common trends amongst researchers and scholars when referring to makers historically.

Impacts on Academics

One of the most common discussions between researchers and experts is the immeasurable impact of the maker space. Much of the work done in a maker space is focused on learning. Students use communication, problem-solving, and critical thinking to work on a task. In this work, students are working through failures and successes (Dweck, 2016). Another factor in measuring the success of a maker space is the inability to collect data from students on the social-emotional impacts of this learning. These

studies focus on the impacts of purposeful play as a component of the work done in a maker space. Purposeful play supports a child's cognitive, social, and physical development (Honey & Zosh et al., 2016). In my research, I found many personal accounts of educators who have found that implementing a maker space in their classroom has led to positive impacts for both students as well as themselves. I find this supportive of my capstone project and important to remember as an educator.

Equity and Opportunity

Another big finding closely related to the development of cognitive and social skills is a study focusing on the importance of purposeful play for students in our low and middle-class populations (Alle-Herndon & Roberts, 2021). In this study, they show that students who grow up under the stress of poverty can lack the foundational skills necessary to progress in learning academic readiness skills (Alle-Herndon & Roberts, 2021). These skills are necessary for students to make progress in the classroom. For myself, this is huge, reaching my students and helping them achieve academic skills is my number one priority. Understanding they may be missing developmental pieces helps assess what a student truly needs to be successful.

Impacts on Educators

In my research, I found many accounts of educators that have implemented a maker space either in their classroom or in a public space. In these accounts were two recurring ideas. Number one was that these people initially had a fear or hesitancy to start this type of space, whether because they didn't know the materials or technology. They always followed this statement with pride in how this work has pushed them and their own growth in learning. These educators also discussed collaborating with others on

maker ideas to share talents and find inspiration (Sierra 2017). The second idea is that for the maker space to be successful under the supervision of one teacher and 27 plus students, you need to implement guidelines to maintain cohesiveness and accountability for what students are working on (Gerstein, 2019).

This understanding has helped guide many of the decisions I have made within my capstone project. It also leads me to my next topic of what implications and limitations come from this work.

Implications

This project as a website is free for public use. However, as an educator looking to implement a maker space in the classroom and administer these lessons, you may need the support of your principal. For these reasons, the lessons published on the website are easy to add to most curricula to reinforce a skill or standard already taught. While policy and standards are changing to support this type of work, as seen in the Next Generation Science Standards, it still may need more mainstream backing. I think it is important to consider as well that the maker space has no data supporting its use to improve students academic success. Therefore the maker space is less likely to receive general funding and once again rely on donations. Making it less likely to be implemented in already under funded schools. This leaves the individual teacher as the implementer.

Limitations

This project does have its limitations. The project is a resource for teachers in the form of a website. To keep this website running, I would need to either pay for it out of my own pocket or secure donations from users. Another option would be to have pop-up ads if the site has enough users.

The growth of this website relies on educators sharing ideas with each other. I will need visibility and people using this website for it to grow. In conjunction with this, as users start submitting lesson ideas, I will need to facilitate the review and publishing of these lesson plans. This should be manageable here and there but could become too time-consuming considering my other responsibilities.

Future Steps

I would like to continue to add resources to this site. By adding resources such as lesson plans, I hope to increase my user base. I would also like to start accepting donations of materials, then redistributing these donations to interested teachers with suggested lesson plans. For this to work, I must begin sharing my website with all educators, friends, and family I know. This includes sharing the site's Instagram page, acquiring followers, and updating this site regularly with lesson plan examples.

There is also room for more research on the effects of the maker space in the classroom for both the teacher and student. It will be important to follow these studies and publish them on the website as they either support or change the current information on website.

Benefit to the Profession

My goal in this work was to provide other educators with a resource they can turn o help them answer the question, *how can you design and implement a maker space for the K-3 classroom*? I believe I have created this and will be able to continue its growth over time. This website helps teachers understand the initial steps in implementing a makerspace. Complete . Offers lesson plan ideas, and builds a community and network of

maker ideas. Supports the teacher in developing a maker mindset when thinking through curriculum, standards, and practicing skills.

Conclusion

Chapter Four reflects on my capstone project, answering *how can you design and implement a maker space for the K-3 classroom*? Chapter four discusses the major learnings from the literature review. These major learnings highlight the most significant trends and influential information in research. Next, this chapter examines the implications and limitations of my project and how these will affect my future work and research. Chapter four will conclude by sharing how this project has enriched and benefited the education profession for both teachers and students.

REFERENCES

Allee-Herndon, K. & Roberts, S. (2021). The Power of Purposeful Play in Primary Grades: Adjusting Pedagogy for Children's Needs and Academic Gains. *Journal of Education. 201*(1), https://doi-org.ezproxy.hamline.edu/10.1177/0022057420903272

Amullah, M. (2023). Constructivism Learning Theory: A Paradigm for Students' Critical Thinking, Creativity, and Problem Solving to Affect Academic Performance in Higher Education. *Cogent Education*. *10*(1), DOI:10.1080/2331186X.2023.2172929

Barniskis, S. (2014) *Makerspace and Teaching Artists.* Teaching Artist Journal. 12(1), from https://www.tandfonline.com/doi/abs/10.1080/15411796.2014.844621

Blair, C. & Raver, C. (2016) Poverty, Stress, and Brain Development: New Directions for Prevention and Intervention. *Academic Pediatrics. 16*(3), S30-S36.https://doi.org/10.1016/j.acap.2016.01.010

Curtis, D. & Carter, M. (2013). *The art of awareness: How observation can transform your teaching (2nd ed.)*. Redleaf Press.

Darling-Hammond, L. et al. (2017) Effective Teacher Professional Development. *Learning Policy Institute.* https://learningpolicyinstitute.org/sites/default/files/product-files/Effective_Teacher_Professional_Development_REPORT.pdf

Dweck, C. (2012). *Mindset: The New Psychology of Success.* Penguin Random House.

Gary, A. (2016, January 19). World Economic Forum. https://www.weforum.org/agenda/2016/01/the-10-skills-you-need-to-thrive-in-the-fourth-industrial-revolution/

Gerstein, J. (2019) *Learning in the Making: How to Plan, Execute, and Assess Powerful Makerspace Lessons.* ASCD

Gomez, A. (2019). The Effects of Makerspace Learning on the Social Interactions among Students with Emotional or Behavioral Disorder (ED604859) Doctoral Dissertation, The University of Texas at San Antonio. https://eric.ed.gov/?id=ED604859

Gurjar, Nandita. (2021). The Italian Makerspace. *Childhood Education*, *97*(3), 48-53. from https://www.tandfonline.com/doi/abs/10.1080/00094056.2021.1930924

Halverson, E. R., & Sheridan, K. M. (2014). The maker movement in education. *Harvard Educational Review, 84*(4), 495–504.

Hatch, M. (2014). *Maker Movement Manifesto: Rules for Innovation in the New World of Crafters, Hackers, and Tinkerers.* McGraw-Hill.

Honey, M. (2013). *Design, Make, Play: Growing the Next Generation of STEM Innovators.* Routledge.

Hwang, G. (2018). Maker Grows Up. *School Library Journal, 64*(5), 36–40. https://www.slj.com.

Konstantinou, D. Parmaxi, A, Zaphiris, P. (2021). Mapping Research Direction on Maker Spaces in Education. *Educational Media International. 58(*3), 223-247. http://doi.org/10.1080/09523987.2021.1976826

Li, Xuedi., Vanderloo, L. M., Keown-Stoneman, C., Cost, Katherine. et al. (2021). Screen Use and Mental Health Symptom in Canadian Children and Youth During the Covid 19 Pandemic. *American Medical Association. 4*(12). p.e2140875-e2140875 https://doi.org/10.1001/jamanetworkopen.2021.40875.

Mann, L. R. T. (2019). *The Process and Function of Makerspace Learning through Design Thinking: A Multi-Site Case Study* (Order No. 28093608). Available from ProQuest Dissertations & Theses Global. (2447003388). https://ezproxy.hamline.edu/login?url=https://www.proquest.com/dissertations-theses/process-function-makerspace-learning-through/docview/2447003388/se-2

NASA. (2-18, January 30). *NASA Stem Engagement: Engineering Design Process*. NASA.gov. https://www.nasa.gov/audience/foreducators/best/edp.html

Obama, B. (April, 2009) Remarks by the President of the National Academy of Sciences annual meeting. Speech presented at the National Academy of Sciences, Washington D.C.

Obniski, M. (2008) *The Arts and Crafts Movement in America.* The Met. https://www.metmuseum.org/toah/hd/acam/hd_acam.htm

Sheridan, K. Halverson, E. Litts, B. Et al. (2014) Learning in the Making: A Comparative Case Study of Three Makerspaces. *Harvard Educational Review. 84*(4), 505-553. DOI:10.17763/haer.84.4.brr34733723j648u

Sierra, K. (2017). If You Build It, They Will Come: How I Started A Makerspace From Scratch. *Knowledge Quest, 46*(2), 42–47.

Thomas, A. (2014). *Making Makers: Kids, Tools, and the Future of Innovation.* Maker Media, Inc.

Tomko, M., Aleman, M., Newstetter, W. et. al. (2021). Participation Pathways for Women Into University Makerspaces. *Journal of Engineering Education. 110*(3), 700-717. http://doi.org/10.1002/jee.20402

Twomey Fosnot, C. (Ed.). (2005). *Constructivism: Theory, Perspectives, and Practice.* Teachers College Press.

U.S. Dept. of Health and Human Services (HHS). (2006). *Research-Based Web Design & Usability Guidelines.* U.S. G.P.O.

Vongkulluksn, V.W., Matewos, A.M., Sinatra, G.M. et al. (2018). Motivational factors in makerspaces: a mixed methods study of elementary school students' situational interest, self-efficacy, and achievement emotions. *IJ STEM Ed, 5*(43). https://doi.org/10.1186/s40594-018-0129-0

Willett, R. (2016). Making, Makers, and Makerspaces: A Discourse Analysis of Professional Journal Articles and Blog Posts about Makerspaces in Public Libraries. *The Library Quarterly: Information, Community, Policy. 86*(3), 313-329. from https://www.jstor.org/stable/26561677

APPENDIX A

Sample Lesson Plan

FIGURE 8.1

Maker Education Lesson Plan

Lesson Component	Lesson Details
Vision and Rationale for the Lesson and Learners	
Student Needs, Interests, and Voice	
Standards Addressed	
Lesson Challenge Statement	
Materials and Tools Needed	
Prerequisite Knowledge and Skills	
Lesson Vocabulary	
Getting Started: The Hook	
Tinkering and Experimentation	
Direct Instruction of Skills and Knowledge	
Learner Planning Time	
Learner Creation Time	
Learner Sharing and Feedback Time	
Documenting Learning and Reflection	
Assessment	
Sharing Out	